Министерство образования и науки Российской Федерации

Федеральное государственное автономное образовательное учреждение высшего профессионального образования

**«Национальный исследовательский ядерный университет «МИФИ»**

**ИНСТИТУТ ИНТЕЛЛЕКТУАЛЬНЫХ КИБЕРНЕТИЧЕСКИХ СИСТЕМ**

**Кафедра №42 (криптологии и кибербезопасности)**

ЛАБОРАТОРНАЯ РАБОТА №2  
по дисциплине: «Системы аналитических вычислений»

**Выполнили:**студенты группы Б19-515  
  
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**Москва, 2022**

Оглавление

[Построение конечного автомата 3](#_Toc99819021)

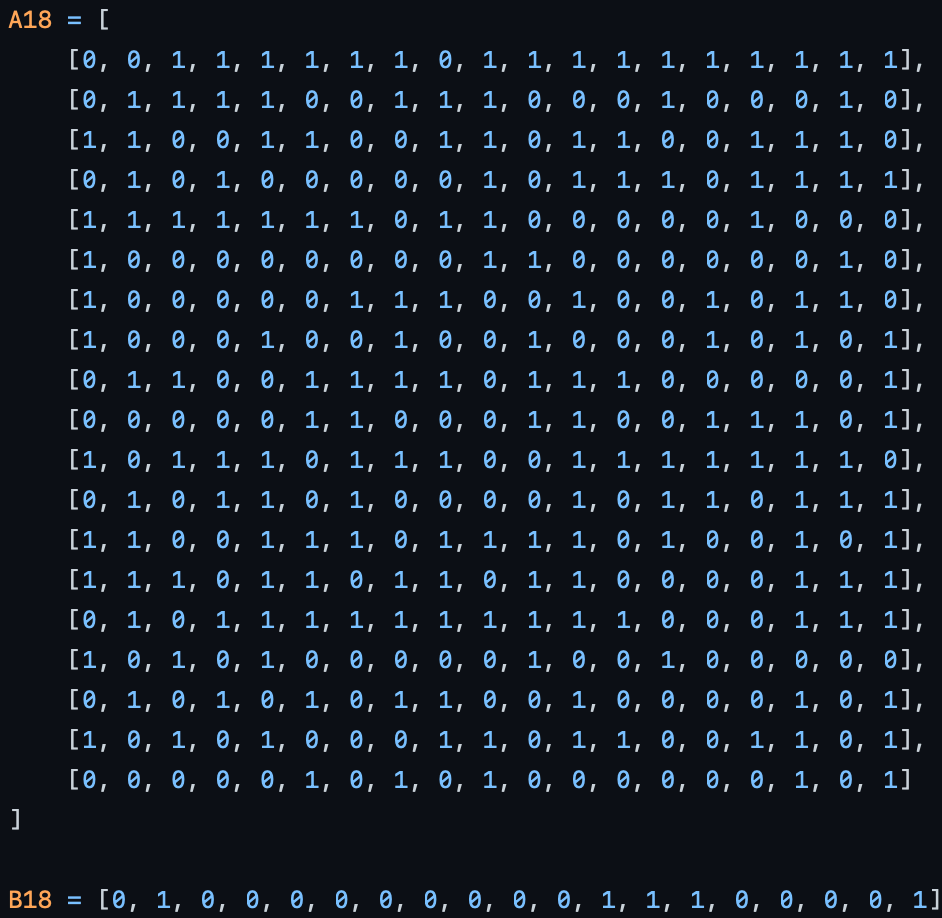
[Нахождение функций де Брейна 5](#_Toc99819022)

[Приложения 7](#_Toc99819023)

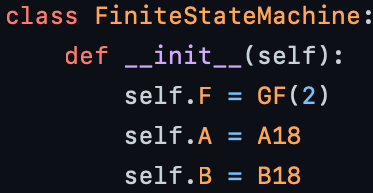
[Заключение 46](#_Toc99819024)

# Построение конечного автомата

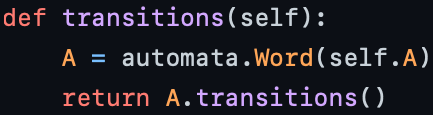
**Вариант №18:**



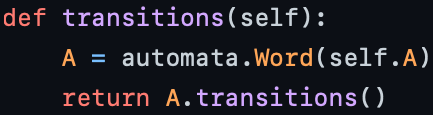
Поставленная задача выполнена с использованием пользовательского класса FiniteStateMachine:



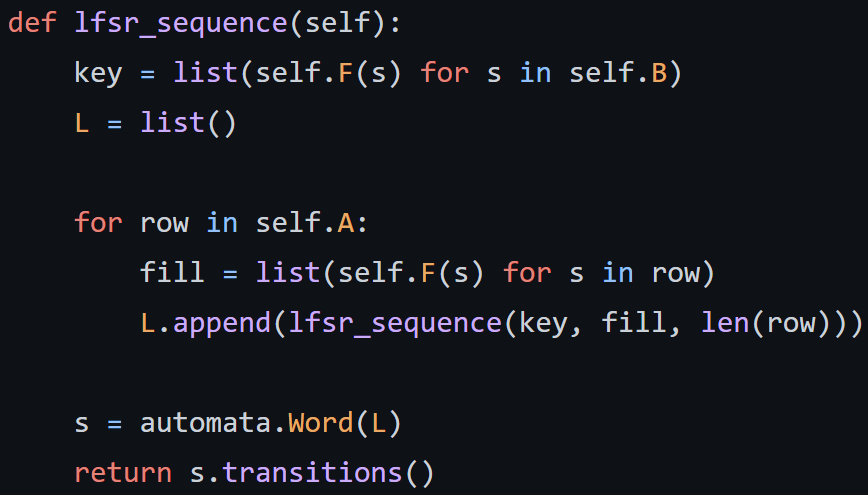
Для создания объекта линейного автомата, соответствующего исходной матрице A, используется встроенный метод Word():



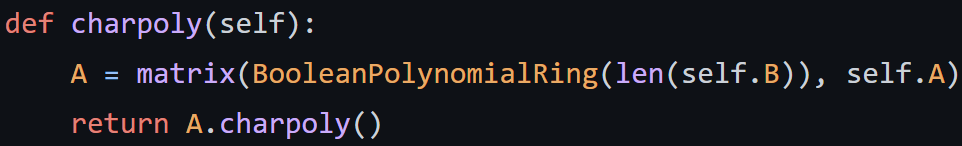
Вывод состояния конечного автомата осуществляется с помощью метода transitions():



Для построения эквивалентного регистра сдвига с линейной обратной связью используется функция lfsr\_sequence():

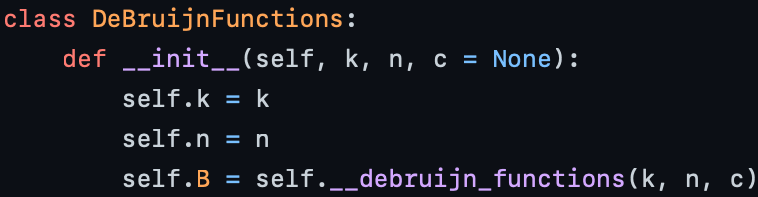


Для вычисления характеристического полинома применяется метод charpoly():

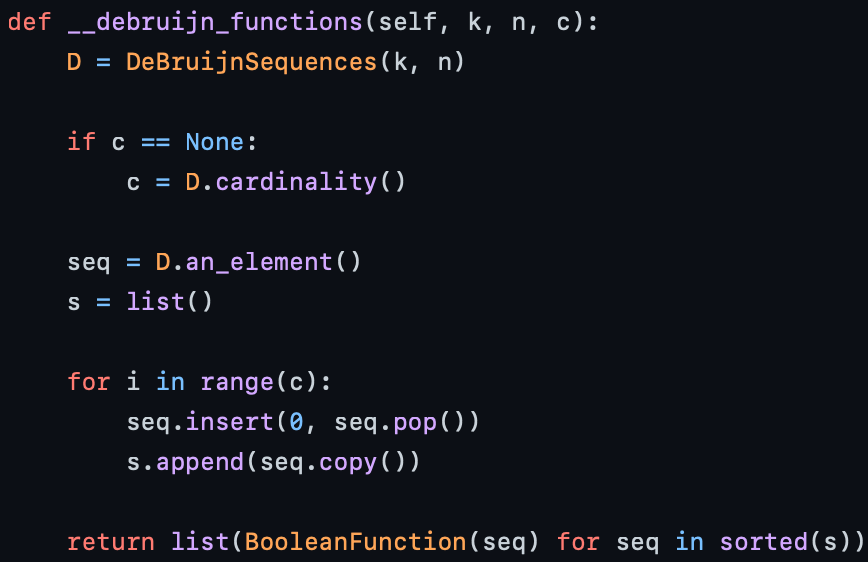


# Нахождение функций де Брейна

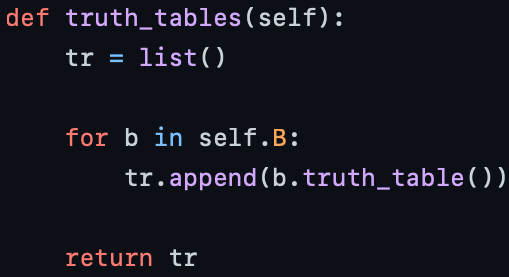
Поставленная задача выполнена с использованием пользовательского класса-обертки DeBruijnFunctions: для обработки функций де Брейна, зависящих от различного числа переменных, используется унифицированный программный интерфейс: конструктор класса принимает опциональный параметр c (*cardinality*), соответствующий количеству рассматриваемых в задаче последовательностей де Брейна:



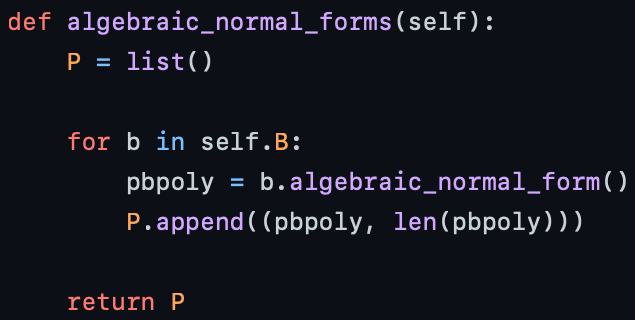
Для инициализации списка булевых функций, соответствующих последовательностям де Брейна, используется метод \_\_debruijn\_functions():



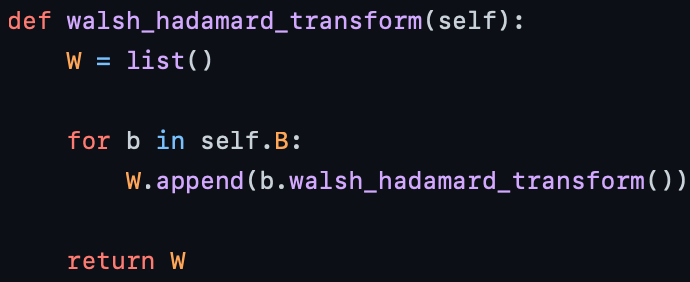
Построение таблиц истинности осуществляется с помощью метода truth\_tables():



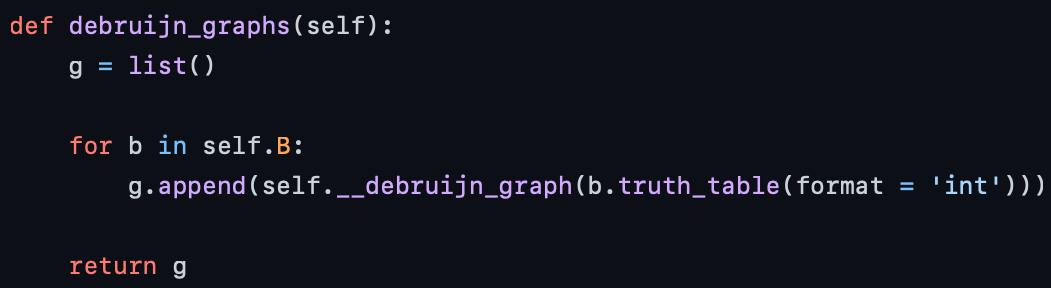
Для вычисления полинома Жегалкина применяется метод algebraic\_normal\_forms():



Расчет коэффициентов Адамара-Уолша производится с использованием метода walsh\_hadamard\_transform():



Нахождение циклов вершин графа осуществляется с помощью метода debruijn\_graphs():



# Приложения

**Листинг функции main:**



**Результат выполнения sage-сценария:**

PROBLEM #1

Transitions:

Transition from 0 to 1: 0,0,1,1,1,1,1,1,0,1,1,1,1,1,1,1,1,1,1|-

Transition from 1 to 2: 0,1,1,1,1,0,0,1,1,1,0,0,0,1,0,0,0,1,0|-

Transition from 2 to 3: 1,1,0,0,1,1,0,0,1,1,0,1,1,0,0,1,1,1,0|-

Transition from 3 to 4: 0,1,0,1,0,0,0,0,0,1,0,1,1,1,0,1,1,1,1|-

Transition from 4 to 5: 1,1,1,1,1,1,1,0,1,1,0,0,0,0,0,1,0,0,0|-

Transition from 5 to 6: 1,0,0,0,0,0,0,0,0,1,1,0,0,0,0,0,0,1,0|-

Transition from 6 to 7: 1,0,0,0,0,0,1,1,1,0,0,1,0,0,1,0,1,1,0|-

Transition from 7 to 8: 1,0,0,0,1,0,0,1,0,0,1,0,0,0,1,0,1,0,1|-

Transition from 8 to 9: 0,1,1,0,0,1,1,1,1,0,1,1,1,0,0,0,0,0,1|-

Transition from 9 to 10: 0,0,0,0,0,1,1,0,0,0,1,1,0,0,1,1,1,0,1|-

Transition from 10 to 11: 1,0,1,1,1,0,1,1,1,0,0,1,1,1,1,1,1,1,0|-

Transition from 11 to 12: 0,1,0,1,1,0,1,0,0,0,0,1,0,1,1,0,1,1,1|-

Transition from 12 to 13: 1,1,0,0,1,1,1,0,1,1,1,1,0,1,0,0,1,0,1|-

Transition from 13 to 14: 1,1,1,0,1,1,0,1,1,0,1,1,0,0,0,0,1,1,1|-

Transition from 14 to 15: 0,1,0,1,1,1,1,1,1,1,1,1,1,0,0,0,1,1,1|-

Transition from 15 to 16: 1,0,1,0,1,0,0,0,0,0,1,0,0,1,0,0,0,0,0|-

Transition from 16 to 17: 0,1,0,1,0,1,0,1,1,0,0,1,0,0,0,0,1,0,1|-

Transition from 17 to 18: 1,0,1,0,1,0,0,0,1,1,0,1,1,0,0,1,1,0,1|-

Transition from 18 to 19: 0,0,0,0,0,1,0,1,0,1,0,0,0,0,0,0,1,0,1|-

LFSR sequence:

Transition from 0 to 1: 0,0,1,1,1,1,1,1,0,1,1,1,1,1,1,1,1,1,1|-

Transition from 1 to 2: 0,1,1,1,1,0,0,1,1,1,0,0,0,1,0,0,0,1,0|-

Transition from 2 to 3: 1,1,0,0,1,1,0,0,1,1,0,1,1,0,0,1,1,1,0|-

Transition from 3 to 4: 0,1,0,1,0,0,0,0,0,1,0,1,1,1,0,1,1,1,1|-

Transition from 4 to 5: 1,1,1,1,1,1,1,0,1,1,0,0,0,0,0,1,0,0,0|-

Transition from 5 to 6: 1,0,0,0,0,0,0,0,0,1,1,0,0,0,0,0,0,1,0|-

Transition from 6 to 7: 1,0,0,0,0,0,1,1,1,0,0,1,0,0,1,0,1,1,0|-

Transition from 7 to 8: 1,0,0,0,1,0,0,1,0,0,1,0,0,0,1,0,1,0,1|-

Transition from 8 to 9: 0,1,1,0,0,1,1,1,1,0,1,1,1,0,0,0,0,0,1|-

Transition from 9 to 10: 0,0,0,0,0,1,1,0,0,0,1,1,0,0,1,1,1,0,1|-

Transition from 10 to 11: 1,0,1,1,1,0,1,1,1,0,0,1,1,1,1,1,1,1,0|-

Transition from 11 to 12: 0,1,0,1,1,0,1,0,0,0,0,1,0,1,1,0,1,1,1|-

Transition from 12 to 13: 1,1,0,0,1,1,1,0,1,1,1,1,0,1,0,0,1,0,1|-

Transition from 13 to 14: 1,1,1,0,1,1,0,1,1,0,1,1,0,0,0,0,1,1,1|-

Transition from 14 to 15: 0,1,0,1,1,1,1,1,1,1,1,1,1,0,0,0,1,1,1|-

Transition from 15 to 16: 1,0,1,0,1,0,0,0,0,0,1,0,0,1,0,0,0,0,0|-

Transition from 16 to 17: 0,1,0,1,0,1,0,1,1,0,0,1,0,0,0,0,1,0,1|-

Transition from 17 to 18: 1,0,1,0,1,0,0,0,1,1,0,1,1,0,0,1,1,0,1|-

Transition from 18 to 19: 0,0,0,0,0,1,0,1,0,1,0,0,0,0,0,0,1,0,1|-

Characteristic polynomial: x^19 + x^18 + x^17 + x^16 + x^15 + x^13 + x^10 + x^6 + x^5 + x^4 + x^2 + 1

PROBLEM #2

Truth tables:

(False, False, False, False, True, False, False, True, True, False, True, False, True, True, True, True)

(False, False, False, True, False, False, True, True, False, True, False, True, True, True, True, False)

(False, False, True, False, False, True, True, False, True, False, True, True, True, True, False, False)

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(False, True, True, False, True, False, True, True, True, True, False, False, False, False, True, False)

(False, True, True, True, True, False, False, False, False, True, False, False, True, True, False, True)

(True, False, False, False, False, True, False, False, True, True, False, True, False, True, True, True)

(True, False, False, True, True, False, True, False, True, True, True, True, False, False, False, False)

(True, False, True, False, True, True, True, True, False, False, False, False, True, False, False, True)

(True, False, True, True, True, True, False, False, False, False, True, False, False, True, True, False)

(True, True, False, False, False, False, True, False, False, True, True, False, True, False, True, True)

(True, True, False, True, False, True, True, True, True, False, False, False, False, True, False, False)

(True, True, True, False, False, False, False, True, False, False, True, True, False, True, False, True)

(True, True, True, True, False, False, False, False, True, False, False, True, True, False, True, False)

Algebraic normal forms:

(x0\*x2 + x0\*x3 + x1\*x2\*x3 + x1\*x2 + x2\*x3 + x2 + x3, 7)

(x0\*x1\*x2 + x0\*x1\*x3 + x0\*x1 + x0\*x2\*x3 + x0\*x3 + x1\*x2\*x3 + x1\*x2 + x2\*x3, 8)

(x0\*x1\*x2 + x0\*x1 + x0\*x2 + x0\*x3 + x1\*x2\*x3 + x1\*x3 + x1 + x3, 8)

(x0\*x1\*x3 + x0\*x2\*x3 + x0\*x2 + x1\*x2\*x3 + x1\*x2 + x1\*x3 + x1 + x2\*x3 + x3, 9)

(x0\*x1 + x0\*x2\*x3 + x0\*x2 + x0 + x1\*x2\*x3 + x1\*x2 + x1\*x3 + x2, 8)

(x0\*x1\*x2 + x0\*x1\*x3 + x0\*x2\*x3 + x0\*x2 + x0\*x3 + x0 + x1\*x2\*x3 + x2\*x3 + x2, 9)

(x0\*x1\*x2 + x0\*x3 + x0 + x1\*x2\*x3 + x1\*x2 + x1 + x2 + x3, 8)

(x0\*x1 + x0\*x2\*x3 + x0 + x1\*x2\*x3 + x1\*x3 + x1 + x2, 7)

(x0\*x1 + x0\*x2\*x3 + x0\*x3 + x0 + x1\*x2\*x3 + x1\*x2 + x1 + x2 + 1, 9)

(x0\*x3 + x0 + x1\*x2\*x3 + x1\*x2 + x1\*x3 + x1 + x2\*x3 + 1, 8)

(x0\*x2 + x0\*x3 + x0 + x1\*x2\*x3 + x2\*x3 + x3 + 1, 7)

(x0\*x1\*x2 + x0\*x1 + x0\*x2 + x0\*x3 + x0 + x1\*x2\*x3 + x1\*x2 + x1\*x3 + x3 + 1, 10)

(x0\*x1\*x2 + x0\*x3 + x1\*x2\*x3 + x1 + x2 + x3 + 1, 7)

(x0\*x1 + x0\*x2\*x3 + x0\*x2 + x0\*x3 + x1\*x2\*x3 + x1 + x2 + 1, 8)

(x0\*x1\*x3 + x0\*x1 + x0\*x2\*x3 + x1\*x2\*x3 + x1\*x3 + x2\*x3 + x2 + x3 + 1, 9)

(x0\*x3 + x1\*x2\*x3 + x1\*x3 + x2\*x3 + x2 + 1, 6)

Walsh-Hadamard coefficients:

(0, -4, 0, -4, 8, -4, 0, 4, 8, 4, 0, -4, 0, 4, 0, 4)

(0, 4, 4, 0, 4, 8, 0, -4, 4, 0, 8, -4, 0, -4, -4, 0)

(0, -4, 0, 4, 0, -4, 8, -4, 4, 0, 4, 8, 4, 0, -4, 0)

(0, 4, 4, 0, -4, -8, 0, 4, 0, 4, 4, 0, 4, 0, 8, -4)

(0, 4, -4, 0, 0, 4, 4, 8, 0, 4, -4, 0, 8, -4, -4, 0)

(0, 4, 4, 0, 4, 8, 0, -4, -4, 0, -8, 4, 0, 4, 4, 0)

(0, -4, 0, 4, 0, 4, -8, 4, -4, 0, 4, 0, 4, 0, 4, 8)

(0, 4, -4, 0, 0, 4, 4, 8, 0, -4, 4, 0, -8, 4, 4, 0)

(0, 4, -4, 0, 0, -4, -4, -8, 8, -4, -4, 0, 0, -4, 4, 0)

(0, -4, 0, -4, -8, 4, 0, -4, 0, -4, 0, -4, 8, 4, 0, -4)

(0, -4, 0, -4, 8, -4, 0, 4, -8, -4, 0, 4, 0, -4, 0, -4)

(0, -4, 0, 4, 0, -4, 8, -4, -4, 0, -4, -8, -4, 0, 4, 0)

(0, -4, 0, 4, 0, 4, -8, 4, 4, 0, -4, 0, -4, 0, -4, -8)

(0, 4, -4, 0, 0, -4, -4, -8, -8, 4, 4, 0, 0, 4, -4, 0)

(0, 4, 4, 0, -4, -8, 0, 4, 0, -4, -4, 0, -4, 0, -8, 4)

(0, -4, 0, -4, -8, 4, 0, -4, 0, 4, 0, 4, -8, -4, 0, 4)

De Bruijn graphs:

{('001', '010'), ('101', '010'), ('001', '011'), ('010', '101'), ('011', '110'), ('000', '001'), ('011', '111'), ('101', '011'), ('010', '100'), ('110', '101'), ('100', '001'), ('000', '000')}

{('111', '111'), ('001', '010'), ('101', '010'), ('001', '011'), ('010', '101'), ('011', '110'), ('000', '001'), ('011', '111'), ('101', '011'), ('010', '100'), ('110', '101'), ('100', '001'), ('111', '110'), ('000', '000')}

{('110', '100'), ('111', '111'), ('001', '010'), ('101', '010'), ('001', '011'), ('010', '101'), ('011', '110'), ('011', '111'), ('101', '011'), ('010', '100'), ('110', '101'), ('100', '001'), ('111', '110')}

{('110', '100'), ('111', '111'), ('101', '010'), ('001', '011'), ('010', '101'), ('011', '110'), ('000', '001'), ('011', '111'), ('101', '011'), ('110', '101'), ('111', '110'), ('000', '000'), ('100', '000')}

{('110', '100'), ('111', '111'), ('101', '010'), ('001', '011'), ('010', '101'), ('011', '110'), ('011', '111'), ('101', '011'), ('010', '100'), ('110', '101'), ('100', '001'), ('111', '110'), ('100', '000')}

{('110', '100'), ('111', '111'), ('001', '010'), ('001', '011'), ('010', '101'), ('011', '111'), ('000', '001'), ('101', '011'), ('010', '100'), ('100', '001'), ('111', '110'), ('000', '000'), ('100', '000')}

{('110', '100'), ('111', '111'), ('001', '010'), ('101', '010'), ('010', '101'), ('011', '110'), ('011', '111'), ('000', '001'), ('101', '011'), ('110', '101'), ('111', '110'), ('000', '000'), ('100', '000')}

{('110', '100'), ('111', '111'), ('001', '010'), ('001', '011'), ('011', '110'), ('011', '111'), ('000', '001'), ('010', '100'), ('100', '001'), ('111', '110'), ('000', '000'), ('100', '000')}

{('001', '010'), ('101', '010'), ('001', '011'), ('010', '101'), ('011', '110'), ('000', '001'), ('011', '111'), ('101', '011'), ('010', '100'), ('110', '101'), ('100', '001'), ('000', '000'), ('100', '000')}

{('110', '100'), ('111', '111'), ('101', '010'), ('001', '011'), ('010', '101'), ('011', '110'), ('011', '111'), ('101', '011'), ('110', '101'), ('100', '001'), ('111', '110'), ('100', '000')}

{('110', '100'), ('111', '111'), ('001', '010'), ('101', '010'), ('010', '101'), ('011', '111'), ('000', '001'), ('101', '011'), ('010', '100'), ('100', '001'), ('111', '110'), ('000', '000'), ('100', '000')}

{('110', '100'), ('111', '111'), ('001', '010'), ('101', '010'), ('001', '011'), ('011', '110'), ('011', '111'), ('000', '001'), ('101', '011'), ('010', '100'), ('100', '001'), ('111', '110'), ('000', '000'), ('100', '000')}

{('110', '100'), ('001', '010'), ('101', '010'), ('001', '011'), ('010', '101'), ('011', '110'), ('000', '001'), ('101', '011'), ('010', '100'), ('110', '101'), ('100', '001'), ('000', '000'), ('100', '000')}

{('110', '100'), ('111', '111'), ('001', '010'), ('101', '010'), ('010', '101'), ('011', '111'), ('000', '001'), ('101', '011'), ('010', '100'), ('110', '101'), ('111', '110'), ('000', '000'), ('100', '000')}

{('110', '100'), ('111', '111'), ('001', '010'), ('101', '010'), ('001', '011'), ('010', '101'), ('011', '110'), ('000', '001'), ('010', '100'), ('110', '101'), ('100', '001'), ('111', '110'), ('000', '000'), ('100', '000')}

{('110', '100'), ('111', '111'), ('001', '010'), ('101', '010'), ('001', '011'), ('011', '110'), ('000', '001'), ('010', '100'), ('110', '101'), ('100', '001'), ('111', '110'), ('000', '000'), ('100', '000')}

PROBLEM #3

Truth tables:

(True, False, False, False, False, False, False, False, False, False, False, True, False, False, False, False, False, False, False, False, True, True, False, False, False, False, False, False, False, True, False, True, False, False, False, False, False, False, False, True, True, True, False, False, False, False, False, False, True, False, False, True, False, False, False, False, False, False, True, False, True, True, False, False, False, False, False, False, True, True, False, True, False, False, False, False, False, False, True, True, True, True, False, False, False, False, False, True, False, False, False, True, False, False, False, False, False, True, False, False, True, True, False, False, False, False, False, True, False, True, False, True, False, False, False, False, False, True, False, True, True, True, False, False, False, False, False, True, True, False, False, True, False, False, False, False, False, True, True, False, True, True, False, False, False, False, False, True, 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(True, True, True, True, True, False, False, False, False, False, False, False, False, False, False, True, False, False, False, False, False, False, False, False, True, True, False, False, False, False, False, False, False, True, False, True, False, False, False, False, False, False, False, True, True, True, False, False, False, False, False, False, True, False, False, True, False, False, False, False, False, False, True, False, True, True, False, False, False, False, False, False, True, True, False, True, False, False, False, False, False, False, True, True, True, True, False, False, False, False, False, True, False, False, False, True, False, False, False, False, False, True, False, False, True, True, False, False, False, False, False, True, False, True, False, True, False, False, False, False, False, True, False, True, True, True, False, False, False, False, False, True, True, False, False, True, False, False, False, False, False, True, True, False, True, True, False, False, False, 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Algebraic normal forms:

(x0\*x1\*x2\*x3\*x4\*x5\*x6\*x7\*x8 + x0\*x1\*x2\*x3\*x4\*x5\*x6\*x8\*x9 + x0\*x1\*x2\*x3\*x4\*x5\*x6\*x8 + x0\*x1\*x2\*x3\*x4\*x5\*x6\*x9 + x0\*x1\*x2\*x3\*x4\*x5\*x7\*x8\*x9 + x0\*x1\*x2\*x3\*x4\*x5\*x7 + x0\*x1\*x2\*x3\*x4\*x5\*x8\*x9 + x0\*x1\*x2\*x3\*x4\*x6\*x7\*x8 + x0\*x1\*x2\*x3\*x4\*x6\*x7\*x9 + x0\*x1\*x2\*x3\*x4\*x6\*x8\*x9 + x0\*x1\*x2\*x3\*x4\*x6\*x9 + x0\*x1\*x2\*x3\*x4\*x6 + x0\*x1\*x2\*x3\*x4\*x7\*x8 + x0\*x1\*x2\*x3\*x4\*x7\*x9 + x0\*x1\*x2\*x3\*x4\*x7 + x0\*x1\*x2\*x3\*x5\*x6\*x7\*x8\*x9 + x0\*x1\*x2\*x3\*x5\*x6\*x7\*x8 + x0\*x1\*x2\*x3\*x5\*x6\*x7\*x9 + x0\*x1\*x2\*x3\*x5\*x6\*x8 + x0\*x1\*x2\*x3\*x5\*x6\*x9 + x0\*x1\*x2\*x3\*x5\*x7\*x8 + x0\*x1\*x2\*x3\*x5\*x8\*x9 + x0\*x1\*x2\*x3\*x5\*x8 + x0\*x1\*x2\*x3\*x5 + x0\*x1\*x2\*x3\*x6\*x7\*x8 + x0\*x1\*x2\*x3\*x6\*x7 + x0\*x1\*x2\*x3\*x6\*x8 + x0\*x1\*x2\*x3\*x6\*x9 + x0\*x1\*x2\*x3\*x6 + x0\*x1\*x2\*x3\*x7\*x8\*x9 + x0\*x1\*x2\*x4\*x5\*x6\*x7\*x8\*x9 + x0\*x1\*x2\*x4\*x5\*x6\*x9 + x0\*x1\*x2\*x4\*x5\*x6 + x0\*x1\*x2\*x4\*x5\*x7\*x8 + x0\*x1\*x2\*x4\*x5\*x7\*x9 + x0\*x1\*x2\*x4\*x5\*x7 + x0\*x1\*x2\*x4\*x6\*x7\*x9 + x0\*x1\*x2\*x4\*x6\*x7 + x0\*x1\*x2\*x4\*x6\*x8\*x9 + x0\*x1\*x2\*x4\*x6 + x0\*x1\*x2\*x4\*x7\*x8\*x9 + x0\*x1\*x2\*x4\*x7\*x9 + x0\*x1\*x2\*x4\*x7 + x0\*x1\*x2\*x4\*x8\*x9 + x0\*x1\*x2\*x4\*x9 + x0\*x1\*x2\*x4 + x0\*x1\*x2\*x5\*x6\*x7\*x8 + x0\*x1\*x2\*x5\*x6\*x7 + x0\*x1\*x2\*x5\*x6\*x8 + x0\*x1\*x2\*x5\*x7\*x8\*x9 + x0\*x1\*x2\*x5\*x7\*x8 + x0\*x1\*x2\*x5\*x7\*x9 + x0\*x1\*x2\*x5\*x7 + x0\*x1\*x2\*x5\*x8 + x0\*x1\*x2\*x6\*x7\*x8 + x0\*x1\*x2\*x6\*x7 + x0\*x1\*x2\*x6\*x9 + x0\*x1\*x2\*x7\*x8\*x9 + x0\*x1\*x2\*x7\*x8 + x0\*x1\*x2\*x7 + x0\*x1\*x2\*x8\*x9 + x0\*x1\*x2 + x0\*x1\*x3\*x4\*x5\*x6\*x7\*x9 + x0\*x1\*x3\*x4\*x5\*x6\*x7 + x0\*x1\*x3\*x4\*x5\*x6\*x8\*x9 + x0\*x1\*x3\*x4\*x5\*x6\*x8 + x0\*x1\*x3\*x4\*x5\*x6\*x9 + x0\*x1\*x3\*x4\*x5\*x7\*x8\*x9 + x0\*x1\*x3\*x4\*x5\*x7\*x8 + x0\*x1\*x3\*x4\*x5\*x7\*x9 + x0\*x1\*x3\*x4\*x5\*x8\*x9 + x0\*x1\*x3\*x4\*x5 + x0\*x1\*x3\*x4\*x6\*x7\*x8 + x0\*x1\*x3\*x4\*x6\*x9 + x0\*x1\*x3\*x4\*x6 + x0\*x1\*x3\*x4\*x7\*x8\*x9 + x0\*x1\*x3\*x4\*x7\*x8 + x0\*x1\*x3\*x4\*x7\*x9 + x0\*x1\*x3\*x4\*x7 + x0\*x1\*x3\*x4\*x8\*x9 + x0\*x1\*x3\*x4\*x8 + x0\*x1\*x3\*x5\*x6\*x8\*x9 + x0\*x1\*x3\*x5\*x6\*x8 + x0\*x1\*x3\*x5\*x7\*x8 + x0\*x1\*x3\*x5\*x7 + x0\*x1\*x3\*x5\*x8\*x9 + x0\*x1\*x3\*x5\*x8 + x0\*x1\*x3\*x5\*x9 + x0\*x1\*x3\*x6\*x7\*x8\*x9 + x0\*x1\*x3\*x6\*x7\*x8 + x0\*x1\*x3\*x6\*x8\*x9 + x0\*x1\*x3\*x6\*x8 + x0\*x1\*x3\*x6\*x9 + x0\*x1\*x3\*x7\*x8 + x0\*x1\*x3\*x7\*x9 + x0\*x1\*x3\*x8 + x0\*x1\*x3\*x9 + x0\*x1\*x4\*x5\*x6\*x7\*x8\*x9 + x0\*x1\*x4\*x5\*x6\*x7\*x8 + x0\*x1\*x4\*x5\*x6\*x7 + x0\*x1\*x4\*x5\*x7\*x8\*x9 + x0\*x1\*x4\*x5\*x7\*x9 + x0\*x1\*x4\*x5\*x7 + x0\*x1\*x4\*x5\*x9 + x0\*x1\*x4\*x5 + x0\*x1\*x4\*x6\*x7\*x8 + x0\*x1\*x4\*x6\*x7 + x0\*x1\*x4\*x6\*x8 + x0\*x1\*x4\*x6\*x9 + x0\*x1\*x4\*x6 + x0\*x1\*x4\*x7\*x8\*x9 + x0\*x1\*x4\*x7\*x9 + x0\*x1\*x4\*x8\*x9 + x0\*x1\*x4\*x8 + x0\*x1\*x4 + x0\*x1\*x5\*x6\*x7\*x8 + x0\*x1\*x5\*x6\*x7\*x9 + x0\*x1\*x5\*x6\*x8\*x9 + x0\*x1\*x5\*x6\*x8 + x0\*x1\*x5\*x6\*x9 + x0\*x1\*x5\*x7\*x9 + x0\*x1\*x5\*x7 + x0\*x1\*x5\*x8 + x0\*x1\*x5\*x9 + x0\*x1\*x5 + x0\*x1\*x6\*x7\*x8\*x9 + x0\*x1\*x6\*x7\*x8 + x0\*x1\*x6\*x7 + x0\*x1\*x6\*x8 + x0\*x1\*x6 + x0\*x1\*x7\*x8\*x9 + x0\*x1\*x7 + x0\*x1\*x8\*x9 + x0\*x1 + x0\*x2\*x3\*x4\*x5\*x6\*x7\*x8\*x9 + x0\*x2\*x3\*x4\*x5\*x6\*x7\*x8 + x0\*x2\*x3\*x4\*x5\*x6\*x7\*x9 + x0\*x2\*x3\*x4\*x5\*x6\*x8\*x9 + x0\*x2\*x3\*x4\*x5\*x6\*x8 + x0\*x2\*x3\*x4\*x5\*x6\*x9 + x0\*x2\*x3\*x4\*x5\*x7\*x8\*x9 + x0\*x2\*x3\*x4\*x5\*x7\*x9 + x0\*x2\*x3\*x4\*x5\*x7 + x0\*x2\*x3\*x4\*x5\*x8\*x9 + x0\*x2\*x3\*x4\*x5\*x8 + x0\*x2\*x3\*x4\*x5 + x0\*x2\*x3\*x4\*x6\*x7\*x8 + x0\*x2\*x3\*x4\*x6\*x7\*x9 + x0\*x2\*x3\*x4\*x6\*x8\*x9 + x0\*x2\*x3\*x4\*x7\*x8 + x0\*x2\*x3\*x4\*x7\*x9 + x0\*x2\*x3\*x4\*x7 + x0\*x2\*x3\*x5\*x6\*x9 + x0\*x2\*x3\*x5\*x6 + x0\*x2\*x3\*x5\*x7\*x9 + x0\*x2\*x3\*x5\*x7 + x0\*x2\*x3\*x5 + 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+ x1\*x2\*x3 + x1\*x2\*x4\*x5\*x6\*x7\*x8 + x1\*x2\*x4\*x5\*x6\*x7\*x9 + x1\*x2\*x4\*x5\*x6\*x8 + x1\*x2\*x4\*x5\*x6\*x9 + x1\*x2\*x4\*x5\*x6 + x1\*x2\*x4\*x5\*x7 + x1\*x2\*x4\*x5\*x8\*x9 + x1\*x2\*x4\*x6\*x8\*x9 + x1\*x2\*x4\*x6\*x9 + x1\*x2\*x4\*x7\*x8\*x9 + x1\*x2\*x4\*x7\*x8 + x1\*x2\*x4\*x7 + x1\*x2\*x4\*x8\*x9 + x1\*x2\*x4\*x8 + x1\*x2\*x4 + x1\*x2\*x5\*x6\*x7\*x8\*x9 + x1\*x2\*x5\*x6\*x7\*x9 + x1\*x2\*x5\*x6\*x8\*x9 + x1\*x2\*x5\*x7\*x8\*x9 + x1\*x2\*x5\*x7\*x9 + x1\*x2\*x5\*x9 + x1\*x2\*x5 + x1\*x2\*x6\*x7\*x9 + x1\*x2\*x7\*x8\*x9 + x1\*x2\*x7\*x8 + x1\*x2\*x8 + x1\*x2\*x9 + x1\*x2 + x1\*x3\*x4\*x5\*x6\*x7 + x1\*x3\*x4\*x5\*x6\*x8\*x9 + x1\*x3\*x4\*x5\*x6\*x8 + x1\*x3\*x4\*x5\*x6 + x1\*x3\*x4\*x5\*x7\*x8\*x9 + x1\*x3\*x4\*x5\*x7 + x1\*x3\*x4\*x5\*x8\*x9 + x1\*x3\*x4\*x5\*x8 + x1\*x3\*x4\*x5 + x1\*x3\*x4\*x6\*x7\*x8 + x1\*x3\*x4\*x6\*x7\*x9 + x1\*x3\*x4\*x7\*x8\*x9 + x1\*x3\*x4\*x7\*x9 + x1\*x3\*x4\*x7 + x1\*x3\*x4\*x8\*x9 + x1\*x3\*x4\*x9 + x1\*x3\*x4 + x1\*x3\*x5\*x6\*x9 + 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x2\*x3\*x4\*x7\*x8\*x9 + x2\*x3\*x4\*x7\*x9 + x2\*x3\*x4\*x9 + x2\*x3\*x4 + x2\*x3\*x5\*x6\*x7\*x8\*x9 + x2\*x3\*x5\*x6\*x7\*x8 + x2\*x3\*x5\*x6\*x7\*x9 + x2\*x3\*x5\*x6\*x9 + x2\*x3\*x5\*x7\*x8 + x2\*x3\*x5\*x7\*x9 + x2\*x3\*x5\*x7 + x2\*x3\*x5\*x8\*x9 + x2\*x3\*x5 + x2\*x3\*x6\*x7\*x8\*x9 + x2\*x3\*x6\*x8\*x9 + x2\*x3\*x7 + x2\*x3\*x8\*x9 + x2\*x3\*x8 + x2\*x3\*x9 + x2\*x4\*x5\*x6\*x7 + x2\*x4\*x5\*x6\*x8 + x2\*x4\*x5\*x6\*x9 + x2\*x4\*x5\*x6 + x2\*x4\*x5\*x7\*x8 + x2\*x4\*x5\*x7 + x2\*x4\*x5\*x8 + x2\*x4\*x5\*x9 + x2\*x4\*x5 + x2\*x4\*x7\*x9 + x2\*x4\*x8\*x9 + x2\*x4\*x8 + x2\*x4\*x9 + x2\*x5\*x6\*x7\*x8 + x2\*x5\*x6\*x8 + x2\*x5\*x6\*x9 + x2\*x5\*x6 + x2\*x5\*x7\*x8 + x2\*x5\*x7\*x9 + x2\*x5\*x8\*x9 + x2\*x6\*x7\*x8\*x9 + x2\*x6\*x8\*x9 + x2\*x6\*x8 + x2\*x6\*x9 + x2\*x6 + x2\*x7\*x9 + x2\*x7 + x2\*x9 + x3\*x4\*x5\*x6\*x7\*x8\*x9 + x3\*x4\*x5\*x6\*x7\*x8 + x3\*x4\*x5\*x6\*x7\*x9 + x3\*x4\*x5\*x6\*x7 + x3\*x4\*x5\*x6\*x8 + x3\*x4\*x5\*x6 + x3\*x4\*x5\*x7\*x8\*x9 + x3\*x4\*x5\*x7\*x8 + x3\*x4\*x5\*x7\*x9 + x3\*x4\*x5\*x8\*x9 + x3\*x4\*x5\*x8 + x3\*x4\*x5\*x9 + x3\*x4\*x6\*x7 + x3\*x4\*x6\*x8 + x3\*x4\*x6\*x9 + x3\*x4\*x7\*x8 + x3\*x4\*x7\*x9 + x3\*x4\*x8\*x9 + x3\*x5\*x6\*x7\*x8 + x3\*x5\*x6\*x7 + x3\*x5\*x6\*x8\*x9 + x3\*x5\*x6\*x8 + x3\*x5\*x7\*x9 + x3\*x5\*x7 + x3\*x5\*x8\*x9 + x3\*x5\*x8 + x3\*x5\*x9 + x3\*x5 + x3\*x6\*x7\*x8 + x3\*x6\*x8\*x9 + x3\*x6 + x3\*x7\*x8\*x9 + x3\*x7\*x8 + x3\*x7 + x3\*x9 + x3 + x4\*x5\*x6\*x8\*x9 + x4\*x5\*x6\*x8 + x4\*x5\*x6\*x9 + x4\*x5\*x7\*x8\*x9 + x4\*x5\*x8\*x9 + x4\*x5 + x4\*x6\*x7\*x9 + x4\*x6\*x7 + x4\*x6\*x8\*x9 + x4\*x6\*x9 + x4\*x7\*x8 + x4\*x7\*x9 + x4\*x8\*x9 + x4 + x5\*x6\*x7\*x8\*x9 + x5\*x6\*x9 + x5\*x7\*x9 + x5\*x7 + x5\*x9 + x5 + x6\*x7\*x9 + x6\*x8\*x9 + x6\*x9 + x7\*x8\*x9 + x7\*x8 + x7 + 1, 507)

Walsh-Hadamard coefficients:

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# Заключение

В данной лабораторной работе построена математическая модель данных, состоящая из конечного автомата и графа де Брейна.

Для линейного автомата, определяемого матрицей А и вектором В:

* построен эквивалентный регистр сдвига;
* записан рекуррентный закон;
* вычислен характеристический многочлен.

Для каждой функции де Брейна приведены:

* цикл вершин графа;
* таблица истинности;
* полином Жегалкина;
* коэффициенты Адамара-Уолша.

Цель, поставленная в начале работы, достигнута; задачи выполнены.